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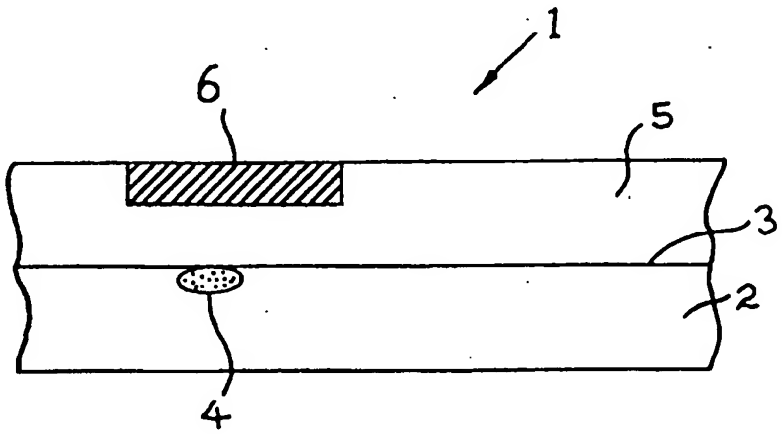
(54) Title: READING PRIMARY AND SECURITY DATA FROM OPTICALLY READABLE DATA STORAGE MEDIA

(57) Abstract

Data is read from an optically readable data storage medium (1) arranged to carry primary data (4) and security data (6). A beam of radiation is directed toward a data storage surface (3) of the optically readable data storage medium (1) and reflected signals are converted into electrical signals, the signals being processed to ascertain the presence of primary data (4) carried by the optically readable data storage medium (1) and security data (6) carried by the medium. Typically an output (such as video or audio) is permitted to output the primary data only upon detection of appropriate security data (6).



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READING PRIMARY AND SECURITY DATA FROM OPTICALLY READABLE DATA STORAGE MEDIA

The present invention relates to reading data from optically readable storage media, and in particular, although not exclusively, to reading data stored on so-called compact discs (CD) or CD-ROMs, CD-I's or the like.

It is known to store data (particularly data in digital form for electronic processing) on optically readable data storage media (typically CDs or CD-ROMs) for subsequent retrieval, processing and output. Usually the output is by means of visual display, video, audio or a combination thereof. CDs or CD-ROMs comprise a reflective data storage surface having a surface topography comprising pits which embody the data stored in digital form. A plastics transparent protective layer (or overlayer) is provided in order to protect the underlying reflective data storage surface.

Counterfeit copying of data storage media such as audio CDs and CD-ROMs for personal computers has become a significant problem, resulting in serious economic loss to owners of proprietary works embodied in the data stored on such media.

Improvements have now been made to the security of optically readable data storage media.

According to a first aspect, the invention provides a method of reading data from an optically readable data storage medium arranged to carry primary data and security data, the method comprising:

i) directing at least one beam of radiation toward a data storage surface of the medium;

ii) converting reflected radiation into electrical signals; and,

iii) processing the electrical signals to ascertain the presence of primary data carried by the medium and security data carried by the medium.

It is preferred that an output is produced related to or derived from the primary data. It is further preferred that the primary data is permitted to be output providing that confirmation of the security data is detected.

The reflected radiation is preferably converted into digital electrical signals.

The security data are preferably unrelated to the primary data carried by the medium (that is the security data are of different quality to the primary data, and should not be readable as primary data).

The primary data is preferably output as visual display, video or audio output or any combination thereof. Desirably, the security data does not influence the output of the data other than to prevent output resulting from the primary data if the security data is not confirmed.

The radiation beam preferably comprises a beam of coherent radiation, preferably a laser beam, advantageously operating in the infra-red region. Desirably the radiation beam is arranged to be focussed in the region of the data storage surface of the medium.

Advantageously, the primary and security data are detected by a common detector. The detector may, for example, comprise a known detector of the type used for reading optically stored data on compact discs, CD-ROM and the like. The detector will typically comprise a phototransistor or the like arranged to detect the reflected radiation and convert it to electrical output.

It is preferred that the primary data signal resulting from the primary data carried by the storage medium is of substantially different frequency (preferably substantially higher) to the security data signal resulting from the security data carried by the storage medium.

Desirably the primary data signal resulting from the primary data carried by the storage medium is of a frequency in the MHz range, whereas the security data signal resulting from the security data carried by the storage medium is in the kHz range.

Preferably, a single beam is directed toward the data storage medium, which single beam when reflected provides a common reflected beam carrying the primary and security data. This is because a single reflected radiation beam is capable of carrying primary and security data superimposed in modulated fashion.

According to a second aspect, the invention provides an optically readable data storage medium arranged to carry optically readable primary data and optically readable security data, the data storage medium comprising a primary data storage surface for carrying the optically readable primary data, and an overlayer overlying the primary data storage surface, the overlayer carrying the optically readable security data.

It is preferred that the optically readable primary data is encoded at the primary data storage surface and preferably comprises the topography of the primary data storage surface which varies in a predetermined manner dependent upon the primary data stored. The primary data stored preferably comprise data in digital form.

It is preferred that the optically readable security data are encoded at the surface of, or within the body of, the overlayer. The data preferably comprise at least one mark or formation (or a series of marks or formations) which is/are not normally visible to the naked eye. Desirably, the mark or series of marks encoding the optically readable security data at the surface of, or within the body of, the overlayer render the overlayer in the region of the mark (or series of marks) partially opaque/partially transmissive to certain frequencies of electromagnetic radiation (preferably partially opaque to laser radiation which is advantageously in the infra red range).

The purpose of this is to ensure that the security marked portion of the overlayer permits an impinging radiation beam (preferably a laser beam) to pass through to the primary data storage surface with at least some distortion or loss of efficiency.

The mark, or series of marks, which encodes the optically readable security data preferably renders the overlayer in the region of the mark (or series of marks) partially opaque and partially transmissive to certain electromagnetic radiation (preferably coherent radiation of the wavelength of a data reading beam) to the extent that radiation passing through the overlayer and being reflected from the primary data storage surface is modulated. The modulation is therefore preferably dependent upon the arrangement of the mark, or series of marks, which embodies the security data encoded at the surface of, or in the body or bulk of, the overlayer.

The overlayer is preferably substantially transparent to visible light as is, desirably, the mark or series of marks encoding the optically readable security data. WO-A-97/06016 and GB-A-2281129 disclose techniques for marking transparent materials in such a way as to have so called "covert" marks. For example, WO-A-97/06016 describes a method of marking bodies having a reflective surface and a coating layer of material transparent to visible light. In this case, the coating layer corresponds to the overlayer described above with reference to the present invention; the method is therefore clearly applicable to the marking of optical data storage media such as CDs, CD-ROMs and the like, for use in the data storage medium and the method according to the invention.

The primary data storage surface in the data storage medium used according to the invention is preferably substantially reflective to visible light, and also preferably to radiation of the frequency used to read the data (which radiation is typically laser radiation in the infra-red range).

The "covert" mark, or series of marks, encoding the optically readable security data is therefore invisible to the naked eye in visible light but detectable by a data reading electromagnetic radiation beam, the resultant electrical signal being modulated.

The mark, or series of marks, encoding the optically readable security data is preferably provided at the surface of (or in the body of) a region of the overlayer overlaying a region of the primary data storage surface carrying primary data. Primary data and security data are therefore arranged to be read simultaneously by a common data reading electromagnetic radiation beam such that primary and security data are derivable from the resultant modulated electrical signal.

According to a third aspect, the invention provides a data reading system for reading data from an optically readable data storage medium arranged to carry primary data and security data, the system comprising:

i) beam means for directing at least one beam of radiation toward a data storage surface of the optically readable data storage medium;

ii) means for converting reflected radiation into electrical signals; and,

iii) processing means for processing the electrical signals to ascertain the presence of primary data carried by the optically readable data storage medium and security data carried by the medium.

It is preferred that the system further comprises output means arranged to produce an output related to the primary data. The output means is preferably arranged to output the primary data as visual display, video or audio output or any combination thereof.

The processor means is advantageously arranged to process the electrical signals derived from the reflected radiation beam such that the primary data are permitted to be output providing the security data are confirmed.

The reflected radiation is preferably converted into digital electrical signals.

Desirably, the processor means operates such that security data do not influence the output of the primary data other than to prevent output resulting from the primary data if the security data is not confirmed.

Desirably, the processor is arranged to recognise constituent signals comprising a modulated signal and process the modulated signal to identify the separate constituent signals. The processor is arranged to evaluate the modulated signal and/or the constituent signals to initiate an appropriate output where permitted. The processor means preferably comprises electronic circuit means, preferably an ASIC.

The beam means preferably comprise a laser source, advantageously operating in the infra-red region. Desirably focussing means is provided arranged to be focus the radiation beam in the region of the data storage surface of the medium.

A single detector is provided for receiving a reflected single beam carrying the primary and security data. The detector comprises the means for converting the reflected radiation in to electrical signals. A known arrangement of beam means and detector of the type used for reading optically stored data on CDs, CD-ROMs or the like may be used. The detector will typically comprise a phototransistor or the like arranged to detect the reflected radiation and convert it to electrical output.

The invention will now be further described in a specific embodiment by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic sectional view of a data storage medium according to the invention;

Figure 2 is a schematic layout of a detection system for reading data stored on optically readable data storage media;

Figure 3a is a schematic layout showing reading of data from an optically readable data storage medium;

Figure 3b is a layout similar to that shown in Figure 3a showing the reading of security data and primary data simultaneously;

Figure 4a is a schematic illustration of a standard digital signal obtained from reading primary data stored conventionally; and

Figure 4b is an illustration of the modulated data signal obtained when reading data according to the invention.

Referring to the drawings, and initially to Figure 1, there is shown an optically readable data storage disc 1 comprising a substrate 2 having a reflective data storage surface 3 provided with pits 4 (only one is shown in Figure 1) which are representative of stored digital data capable of being reproduced as a digital electronic signal.

A polycarbonate overlayer 5 (substantially transparent to visible light) overlays or coats substrate 2 so as to protect the reflective data storage surface 3. In accordance with the invention, the polycarbonate overlayer 5 is provided with a covert mark 6 which is formed so as to be substantially invisible to the naked eye in visible light, because it is substantially transparent to visible light.

The mark 6 can be formed in accordance with known methods, such as those disclosed, for example, in GB-A-2281129 or WO-A-97/06016. The covert mark 6 can be formed at the outer surface of the polycarbonate layer 5, or within the body of the polycarbonate layer 5, so that there is no physical evidence that the outer surface of polycarbonate layer 5. As shown in Figure 1, the covert mark 6 is arranged to overlie one or more pits 4 embodying the primary digital data. The covert mark 6 is partially transparent/partially opaque to the passage therethrough of infra-red radiation in the form of a laser beam transmitted from a data reader laser 7, such that on passing through the region of polycarbonate layer 5 provided with covert mark 6, the laser beam is transmitted to read the digital date (in the form of pits 4) with distortion or loss of efficiency.

Referring now to Figure 2, the laser 7 comprises a conventional diode laser arranged to produce a beam 8 which passes through a one-way reflector 9 and is focussed at the reflective primary data storage surface 3 of the disc 1. The beam 8 is reflected from the primary data storage surface and is deflected by deflector 9 passing to a phototransistor sensor 10 which produces a digital electrical signal corresponding to the data carried by beam 8. The signals are then processed by processor 11 and subsequently output (to the video, audio or visual display) 12 is generated.

These components can be found in conventional data readers for optically readable data storage media. In accordance with the present invention, the processor 11 is used to analyse the signals received from detector 10 in response to the reflected beam 8 to ascertain the presence of both primary data to be output, and also the presence of security data carried by the beam as a result of passing through the covert mark 6.

The processor 11 acts such that the primary data is only permitted to be output, providing the security data is confirmed. A single beam 8 can be used to carry both the primary and the security data, because of the nature of the partial transmittability of covert mark 6 (dependent on the predetermined configuration of the mark as applied to overlayer 5); this means that the reflected beam is in effect modulated and comprises primary data information superposed with the security data information contributed by the covert mark 6. This results in a modulated signal comprising the digital signal of the primary data superposed with the unique signature signal of the covert mark 6.

Figure 3a shows, in simplified exemplary form, the standard signal (unmodulated); Figure 3b shows the modulated signal resulting from the reflected beam 8 carrying both primary data information and security data information.

Figure 4a shows a signal reaching the processor 11 in a situation corresponding to that shown in Figure 3a where no covert mark is present; Figure 4b shows a similar signal reaching processor 11 in the situation shown in Figure 3b, where the reflected beam is modulated, carrying both primary data information and also security data information.

The processor 11 checks to see whether the signal is modulated in such a way as to show that the optical data storage medium 1 carries an approved covert mark 6. If the processor does not confirm the presence of an approved covert mark, the primary data is not permitted to be output at the output 12.

If the approved mark is confirmed, the processor acts to separate the modulating signal component arising from the covert mark 6, and permits the digital signal arising from the primary data recorded on the storage medium 1 to be output, in the form shown in Figure 4a.

The invention provides a convenient way of marking optically readable data storage media with covert marks which cannot be seen visually, nor easily reproduced when and if found. Apparatus, such as disc drives of personal computers, or compact disc players, when fitted with a reading system in accordance with the invention, can be specifically designed to operate to produce an output from the disc, only when authenticated data storage media are used. The invention therefore provides a significant anti-counterfeiting measure for use with optically readable data storage media.

CLAIMS:

1. A method of reading data from an optically readable data storage medium arranged to carry primary data and security data, the method comprising:

   i) directing at least one beam of radiation toward a data storage surface of the medium;
   ii) converting reflected radiation into electrical signals; and
   iii) processing the electrical signals to ascertain the presence of primary data carried by the medium and security data carried by the medium.

2. A method according to claim 1, wherein an output is produced related to or derived from the primary data.

3. A method according to claim 2, wherein the primary data is permitted to be output providing that confirmation of the security data is detected.

4. A method according to any of claims 1 to 3, wherein the reflected radiation is converted into digital electrical signals.

5. A method according to any of claims 1 to 4, wherein the security data are unrelated to the primary data carried by the medium.

6. A method according to any of claims 1 to 5, wherein the primary data is output as visual display, video or audio output or any combination thereof.

7. A method according to any of claims 1 to 6, wherein the radiation beam comprises a beam of coherent radiation.

8. A method according to claim 7, wherein the radiation beam is a laser beam.

9. A method according to claim 8, wherein the laser beam operates in the infra-red region.

10. A method according to any of claims 7 to 9, wherein the radiation beam is arranged to be focussed in the region of the data storage surface of the medium.

11. A method according to any of claims 1 to 10, wherein the primary and security data are detected by a common detector.

12. A method according to any of claims 1 to 11, wherein the primary data signal resulting from the primary data carried by the storage medium is of substantially different frequency to the security data signal resulting from the security data carried by the storage medium.

13. A method according to claim 12, wherein the primary data signal resulting from the primary data carried by the storage medium is of a substantially higher frequency to the security data signal resulting from the security data carried by the storage medium.

14. A method according to claim 12 or 13, wherein the primary data signal resulting from the primary data carried by the storage medium is of a frequency in the MHZ range, whereas the security data signal resulting from the security data carried by the storage medium is in the kHz range.

15. A method according to any of claims 1 to 14, wherein a single beam is directed toward the data storage medium, which single beam when reflected provides a common reflected beam carrying the primary and security data.

16. An optically readable data storage medium arranged to carry optically readable primary data and optically readable security data, the data storage medium comprising a primary data storage surface for carrying the optically readable primary data, and an overlayer overlying the primary data storage surface, the overlayer carrying the optically readable security data.

17. A medium according to claim 16, wherein the optically readable primary data is encoded at the primary data storage surface.

18. A medium according to claim 16 or 17, wherein the optically readable primary data comprises the topography of the primary data storage surface which varies in a predetermined manner dependent upon the primary data stored.

19. A medium according to claim 18, wherein the primary data stored comprise data in digital form.

20. A medium according to any of claims 16 to 19, wherein the optically readable security data are encoded at the surface of, or within the body of, the overlayer.

21. A medium according to any of claims 18 to 20, wherein the data comprise at least one mark or formation which is not normally visible to the naked eye.

22. A medium according to claim 21, wherein the data comprise a series of marks or formations which are not normally visible to the naked eye.

23. A medium according to claim 21 or 22, wherein the mark encoding the optically readable security data renders the overlayer in the region of the mark partially opaque/partially transmissive to certain frequencies of electromagnetic radiation.

24. A medium according to claim 23, wherein the mark encoding the optically readable security data renders the overlayer in the region of the mark partially opaque/partially transmissive to a data reading beam.

25. A medium according to claim 24, wherein the data reading beam is in the infra red range.

26. A medium according to any of claims 23 to 25, configured such that the radiation passing through the overlayer and being reflected from the primary data storage surface is modulated.

27. A medium according to claim 26, wherein the modulation is dependent upon the arrangement of the mark, or series of marks, which embodies the security data encoded at the surface of, or in the body or bulk of, the overlayer.

28. A medium according to any of claims 16 to 27, wherein the overlayer is substantially transparent to visible light.

29. A medium according to any of claims 21 to 28, wherein the mark or series of marks encoding the optically readable security data is substantially transparent to visible light.

30. A medium according to any of claims 16 to 29, wherein the primary data storage surface is substantially reflective to visible light.

31. A medium according to any of claims 16 to 30, wherein the primary data storage surface is substantially reflective to radiation of the frequency used to read the data.

32. A medium according to claim 31, wherein the radiation is in the infra-red range.

33. A medium according to any of claims 21 to 32, wherein the mark, or series of marks, encoding the optically readable security data is provided at the surface of a region of the overlayer overlaying a region of the primary data storage surface carrying primary data.

34. A medium according to any of claims 21 to 32, wherein the mark, or series of marks, encoding the optically readable security data is provided in the body of a region of the overlayer overlaying a region of the primary data storage surface carrying primary data.

35. A data reading system for reading data from an optically readable data storage medium arranged to carry primary data and security data, the system comprising:

i) beam means for directing at least one beam of radiation toward a data storage surface of the optically readable data storage medium;
ii) converter means for converting reflected radiation into electrical signals; and
iii) processing means for processing the electrical signals to ascertain the presence of primary data carried by the optically readable data storage medium and security data carried by the medium.

36. A data reading system according to claim 35, wherein the system further comprises output means arranged to produce an output related to the primary data.

37. A data reading system according to claim 36, wherein the output means is arranged to output the primary data as visual display, video or audio output or any combination thereof.

38. A data reading system according to any of claims 35 to 37, wherein the processor means is arranged to process the electrical signals derived from the reflected radiation beam such that the primary data are permitted to be output providing the security data are confirmed.

39. A data reading system according to claim 38, wherein the reflected radiation is converted into digital electrical signals.

40. A data reading system according to claim 38 or 39, wherein the processor means operates such that security data do not influence the output of the primary data other than to prevent output resulting from the primary data if the security data is not confirmed.

41. A data reading system according to any of claims 35 to 40, wherein the processor is arranged to recognise constituent signals comprising a modulated signal and

process the modulated signal to identify the separate constituent signals.

42. A data reading system according to claim 41, wherein the processor is arranged to evaluate the modulated signal and/or the constituent signals to initiate an appropriate output wherein permitted.

43. A data reading system according to any of claims 35 to 42, wherein the processor means comprises electronic circuit means.

44. A data reading system according to claim 43, wherein the electronic circuit means is an ASIC.

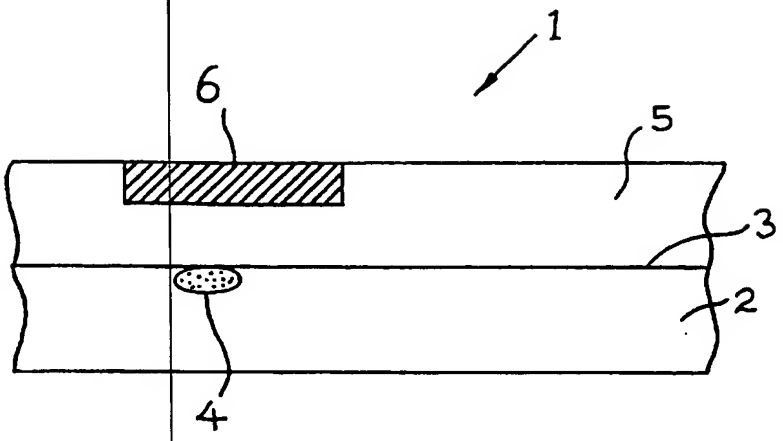
45. A data reading system according to any of claims 35 to 44, wherein the beam means comprise a laser source.

46. A data reading system according to claim 45, wherein the laser source operates in the infra-red region.

47. A data reading system according to any of claims 35 to 46, wherein focussing means is provided arranged to focus the radiation beam in the region of the data storage surface of the medium.

48. A data reading system according to any of claims 35 to 47, wherein a single detector is provided for receiving a reflected single beam carrying the primary and security data.

FIGURE 1



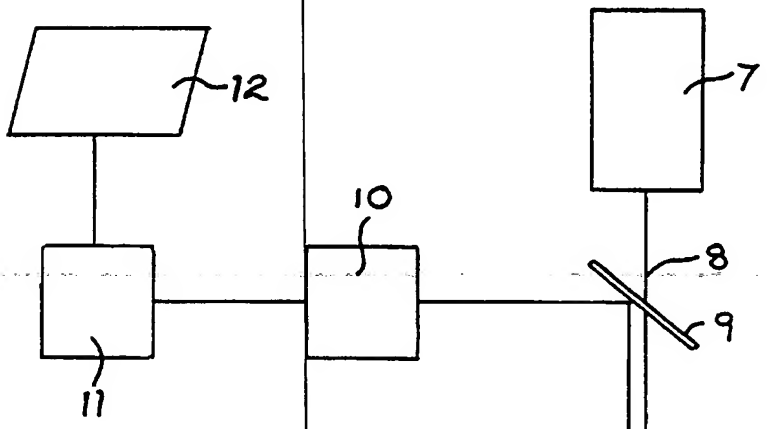


FIGURE 2

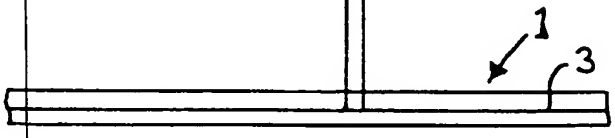


FIGURE 3a

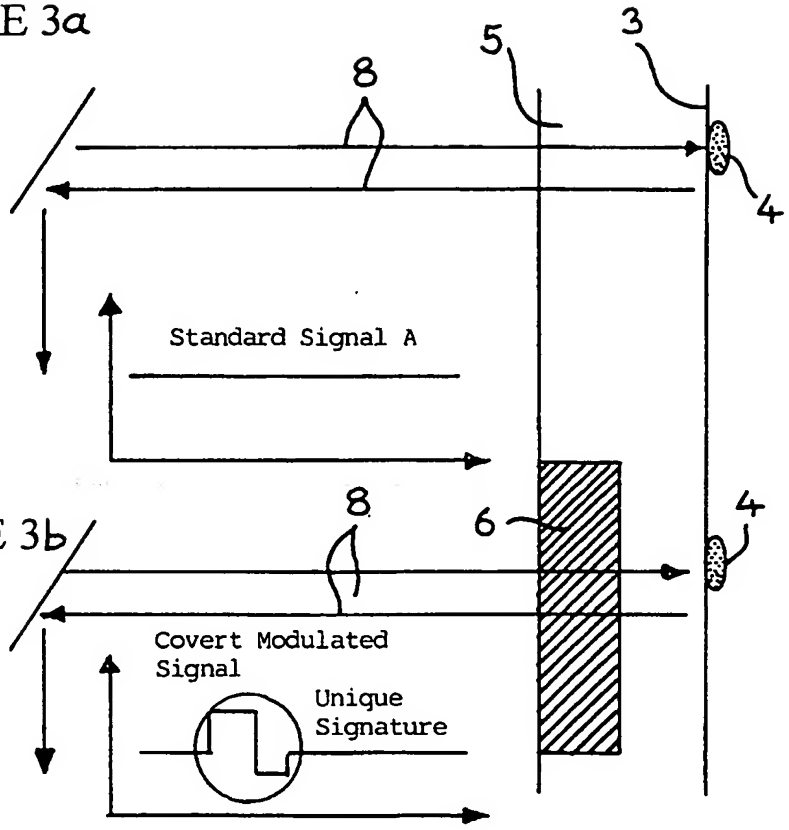
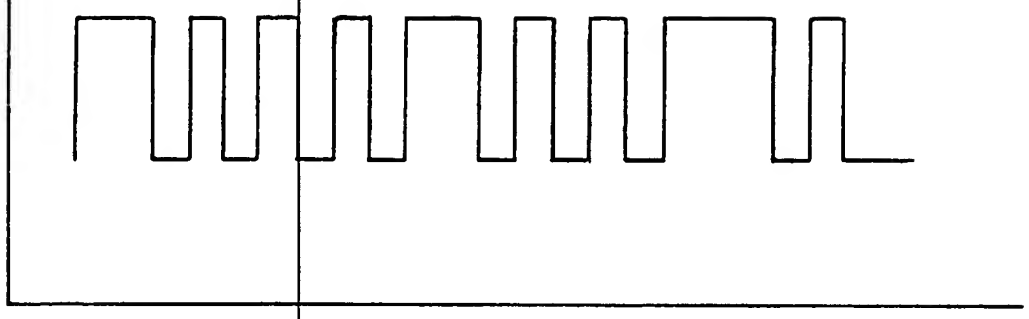


FIGURE 3b

FIGURE 4a



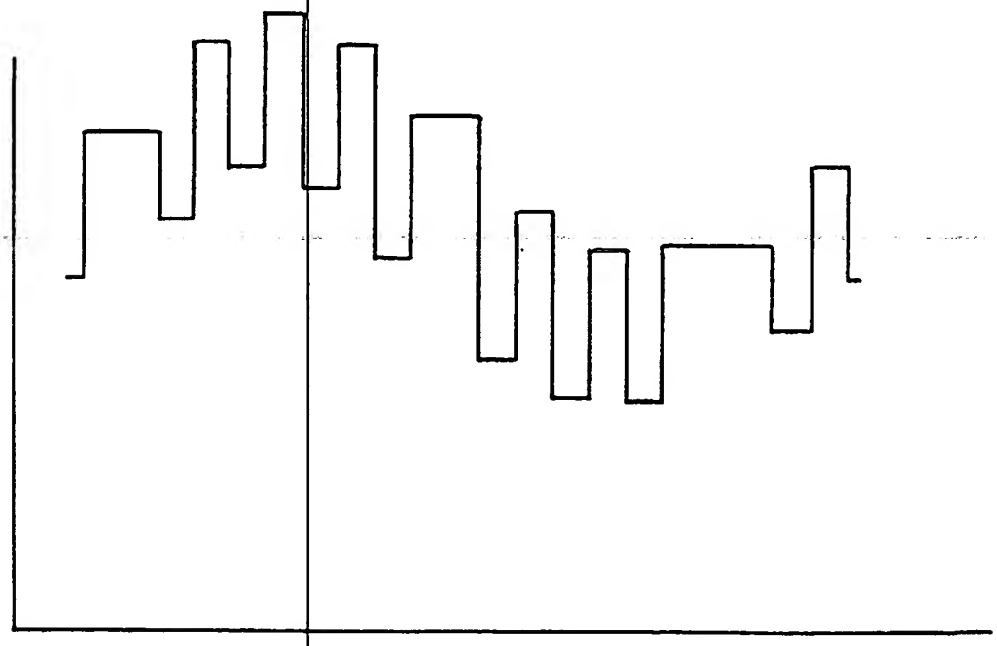


FIGURE 4b

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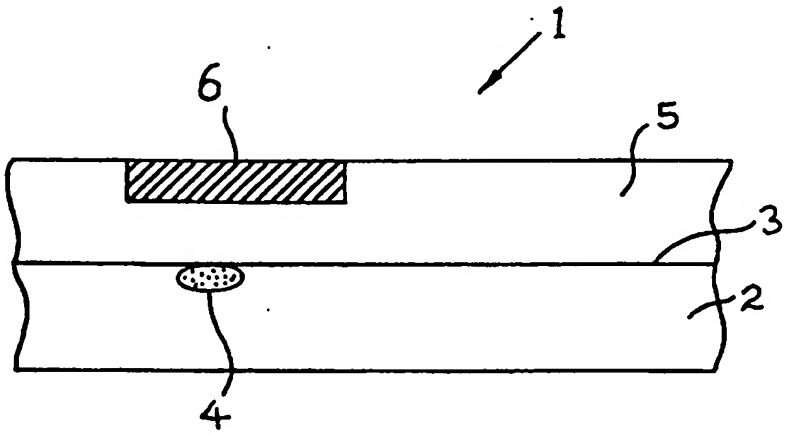
(57) Abstract

Data is read from an optically readable data storage medium (1) arranged to carry primary data (4) and security data (6). A beam of radiation is directed toward a data storage surface (3) of the optically readable data storage medium (1) and reflected signals are converted into electrical signals, the signals being processed to ascertain the presence of primary data (4) carried by the optically readable data storage medium (1) and security data (6) carried by the medium. Typically an output (such as video or audio) is permitted to output the primary data only upon detection of appropriate security data (6).



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INTERNATIONAL SEARCH REPORT

International Application No
PCT 3 99/02891

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11B7/24 G11B7/007 G11B20/00 G11B23/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 12, 31 October 1998 (1998-10-31) & JP 10 199032 A (VICTOR CO OF JAPAN LTD), 31 July 1998 (1998-07-31) abstract -----	1-8,10, 11, 35-40, 43-45, 47,48

☐ Further documents are listed in the continuation of box C.

☐ Patent family members are listed in annex.

* Special categories of cited documents :

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 December 1999	03.03.00

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Poth, H

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INTERNATIONAL SEARCH REPORT

Int tional application No.
PCT/GB 99/02891

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-8, 10, 11, 35-40, 43-45, 47, 48

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1-8, 10, 11, 35-40, 43-45, 47, 48

"Detection of both primary data and security data"

2. Claims: 9, 46

"Infrared beam"

3. Claims: 12-34

"Different frequencies"

4. Claims: 41, 42

"Separate signal identification"

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT, 3 99/02891

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 10199032 A	31-07-1998	NONE	

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